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# THE ONSET OF GALACTIC WINDS IN EARLY-TYPE GALAXIES

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GALACTIC WINDS  
IN EARLY-TYPE GALAXIES  
Final Report

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Final Report

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Below we summarize our work as part of the Astrophysics Data Program Investigation, "The Onset of Galactic Winds in Early-Type Galaxies". We completed the spectral analysis of 31 early-type galaxies to investigate whether their x-ray emission was predominantly due to thermal bremsstrahlung from a hot gaseous corona or emission from discrete, galactic sources such as x-ray binaries. If a corona dominates the x-ray emission, its spectra is expected to be relatively cool (0.5 - 1 keV) compared to the harder emission associated with x-ray binaries in our galaxy, the Magellanic Clouds and M31. While it is generally accepted that the x-ray emission in luminous E and S0 galaxies arises from hot coronae, the status of hot gas in lower luminosity (and hence lower mass) galaxies is less clear. Calculations show that, for a given supernova rate, a critical galaxy luminosity (mass) exists below which the gas cannot be gravitationally confined and a galactic wind is predicted to be effective in expelling gas from the galaxy (Loewenstein and Mathews, 1987; David et al. 1990). Since significant mass (a dark halo) is required to hold a hot, gaseous corona around a galaxy, we expect that the faintest, smallest galaxies will not have a hot corona, but their x-ray emission will be dominated by galactic sources or by an active galactic nuclei. In the sample we tested which spanned the absolute magnitude range from -21.5 to -19.5, we found that except for two galaxies whose x-ray emission was dominated by an active nucleus, that the others were consistent with emission from hot gas. We also found that there is a correlation between gas temperature and galaxy magnitude (mass), such that the brighter, more luminous galaxies have hotter gas temperatures. Thus even at relatively faint magnitudes, the dominant emission from early-type galaxies appears to be hot gas.

We also carried out an investigation of the x-ray surface brightness distribution of the x-ray emission for about 100 early type galaxies to determine whether the x-ray emission from galaxies are extended. Extended x-ray emission is expected if the emission is due to a hot gaseous corona. We determined the ratio of the source counts in two annuli (0-80 arcseconds and 80-160 arc seconds) for each galaxy and analyzed these ratios using a maximum likelihood estimator to determine the errors on the ratios. Even for weak sources, this ratio provides a sensitive test for source extent. We then compared these ratios to a sample of quasars (all unresolved sources) and have determined which galaxies are extended and which are consistent with point sources.

A first paper including the Einstein x-ray fluxes for 147 early-type galaxies has been published in the Astrophysical Journal Supplement Series (with Roberts, Hogg, Bregman, Forman entitled "Interstellar Matter in Early-Type Galaxies"). A second paper will describe the spectral and extent analysis carried out for this galaxy sample. These results also have been presented at scientific conferences and in colloquia.